Field Evaluation of UNI-TEC SENS-IT Sensor

South Coast AQMD

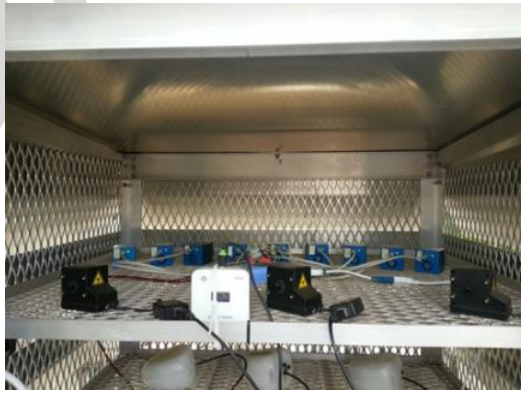
AQ-SPEC
Air Quality Sensor Performance Evaluation Center

Background

- From 7/1/2015 to 7/31/2015, nine **SENS-IT** gaseous sensors were deployed in Rubidoux and were run side-by-side SCAQMD Federal Reference/Equivalent Method (FRM/FEM) instruments measuring the same pollutants

- SENS-IT (*9 units tested*):
  - Gaseous sensors (metal oxide; non-FRM, non-FEM)
  - Single pollutant measurements [i.e. 3 units for CO (ppm); 3 units for NO_2 (ppb); 3 units for Ozone (ppb)]
  - Unit cost: ~$2,200
  - Time resolution: 1-min
  - Units IDs:
    - NO_2 sensors: U194, U144, U068
    - Ozone sensors: U190, U057, U059
    - CO sensors: U197, U247, U245

- SCAQMD FRM/FEM instruments:
  - CO instrument; cost: ~$10,000
    - Time resolution: 1-min
  - NOx instrument; cost: ~$11,000
    - Time resolution: 1-min
  - O_3 instrument; cost: ~$7,000
    - Time resolution: 1-min

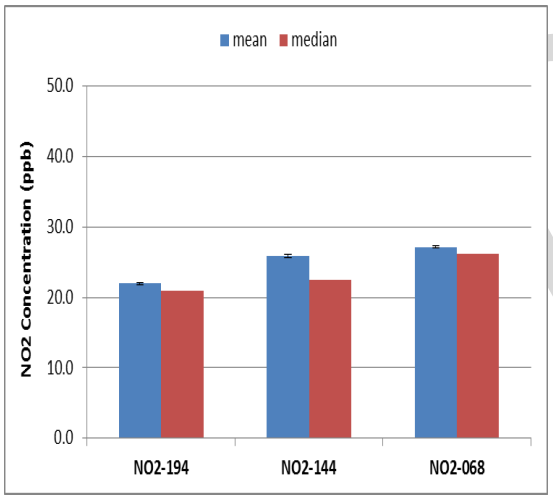


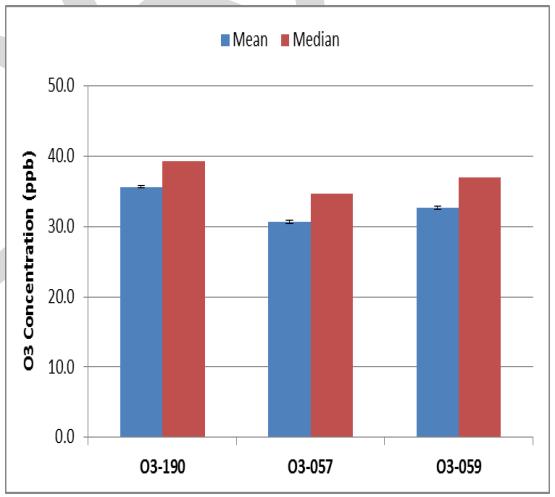
Data validation & recovery

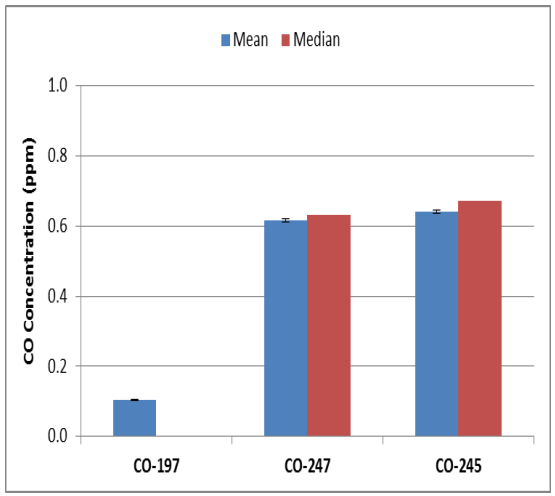
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- For all units/pollutants tested data recovery was very high (i.e. >99%)

SENS-IT; intra-model variability

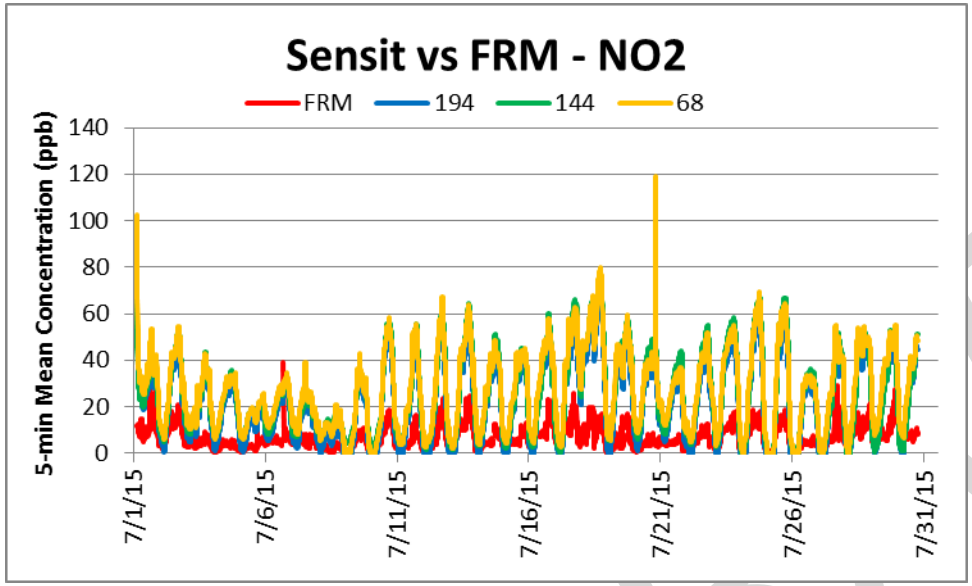
- Relatively low intra-model variability was observed for all SENS-IT sensors. However, unit U197 (measuring CO) provided invalid data.



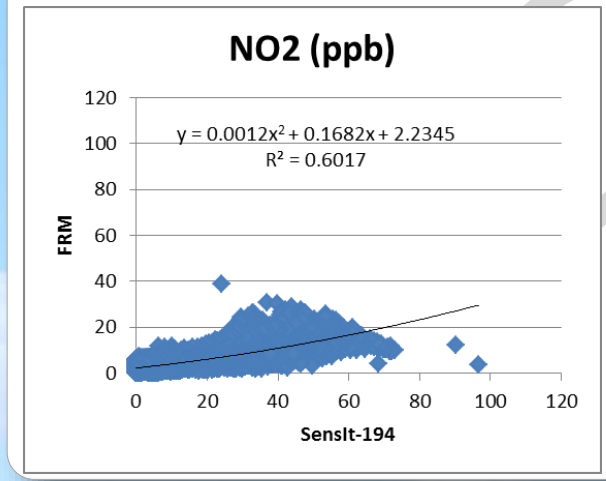


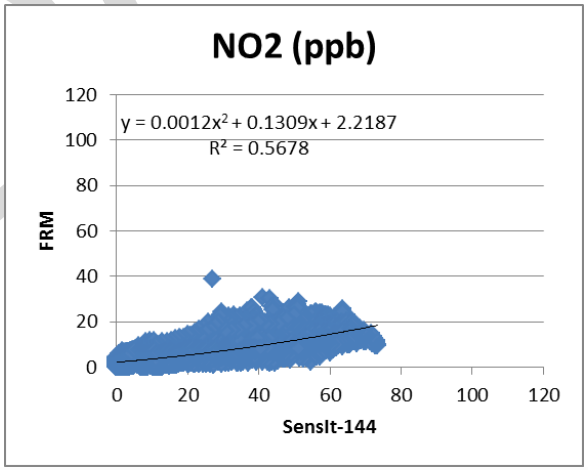


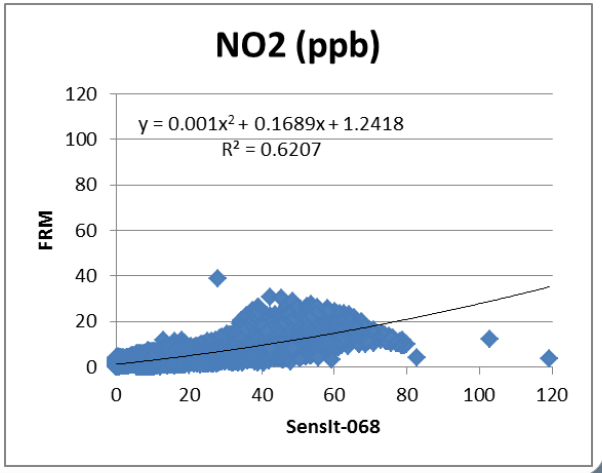
SENS-IT vs FRM (NO2; 5-min mean)



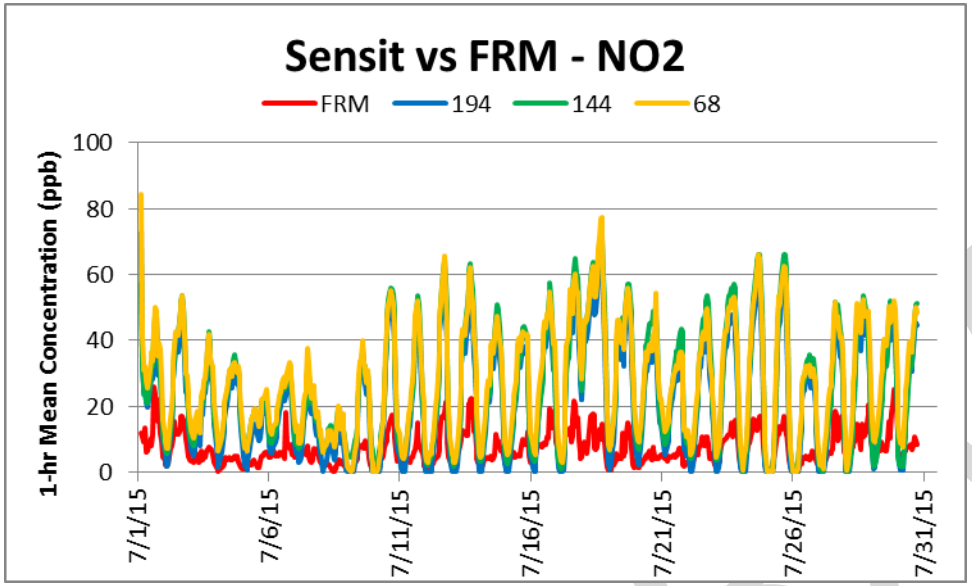
- Overall, all NO_2 measurements correlate fairly well with the corresponding FRM data ($0.57<R^2<0.62$), but the three SENS-IT sensors largely overestimated measured NO_2 concentrations



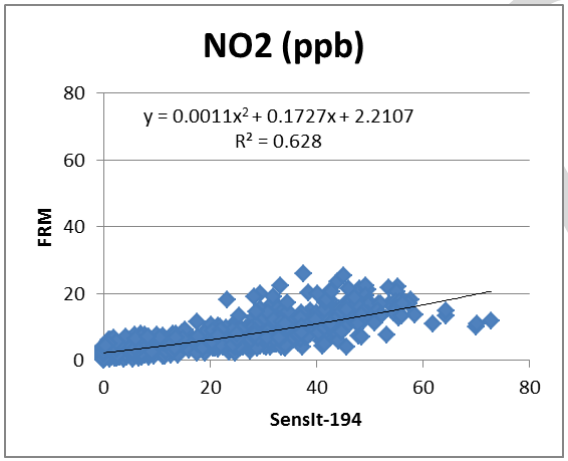


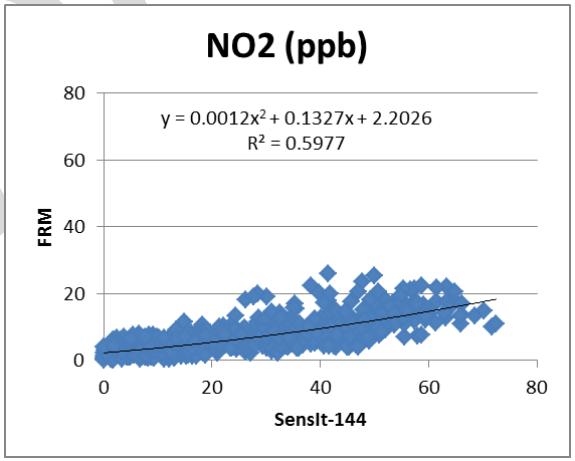


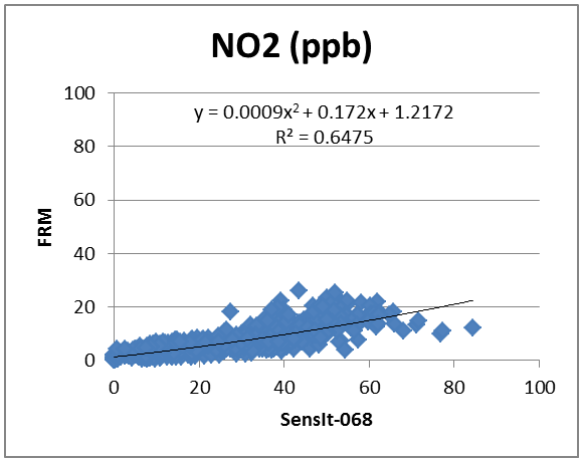
SENS-IT vs FRM (NO2; 1-hr mean)



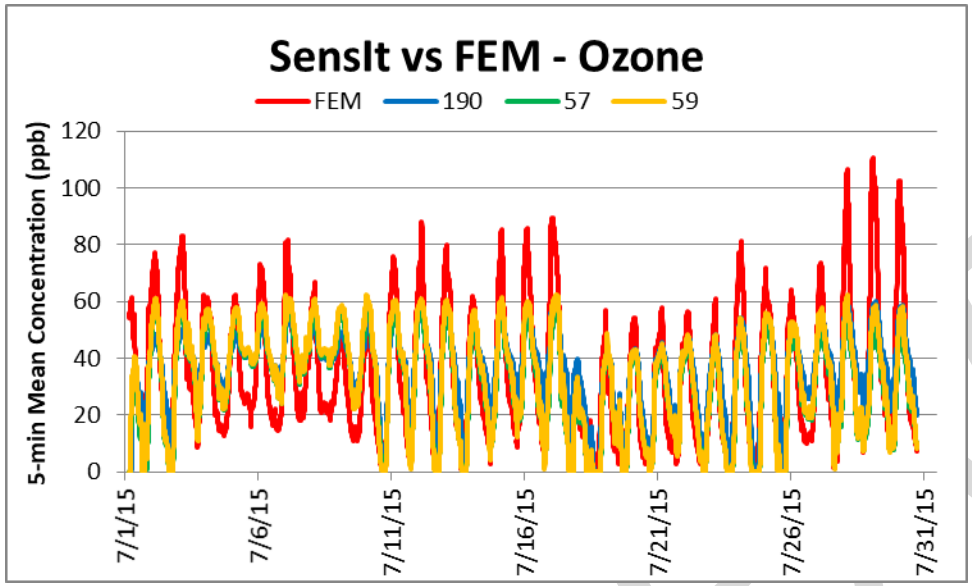
- NO_2 measurements correlate fairly well with the corresponding FRM data ($0.60<R^2<0.65$), but the three SENS-IT sensors largely overestimated measured NO_2 concentrations



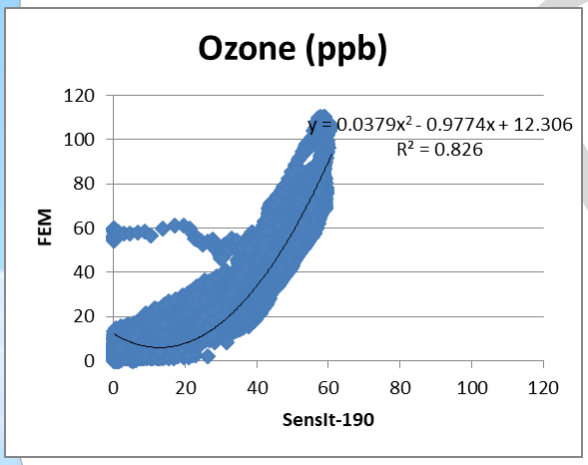


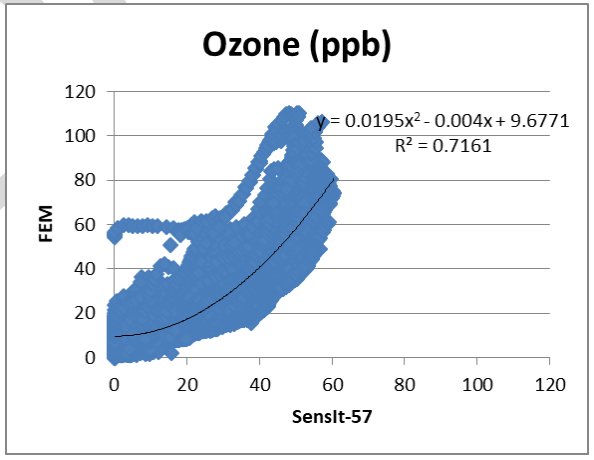


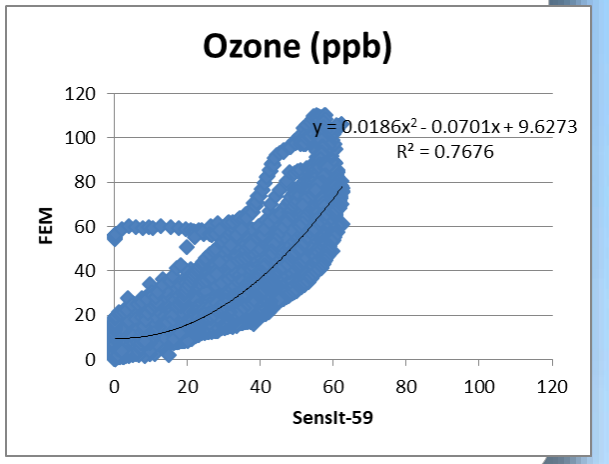
SENS-IT vs FEM (Ozone; 5-min mean)



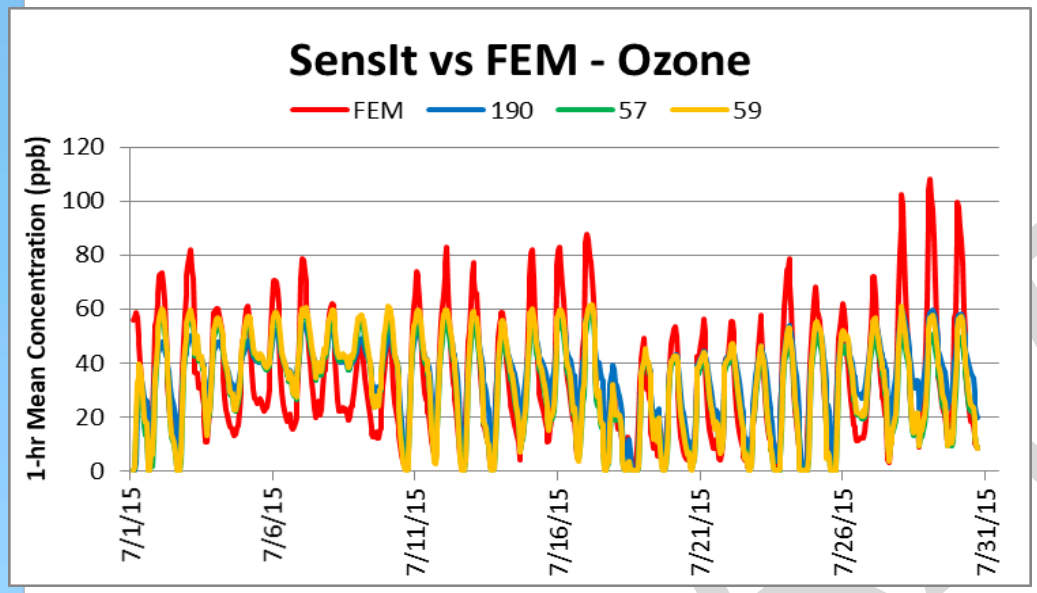
- Ozone measurements correlate very well with the corresponding FEM data ($0.72<R^2<0.83$), but the three SENS-IT sensors underestimated measured Ozone concentrations



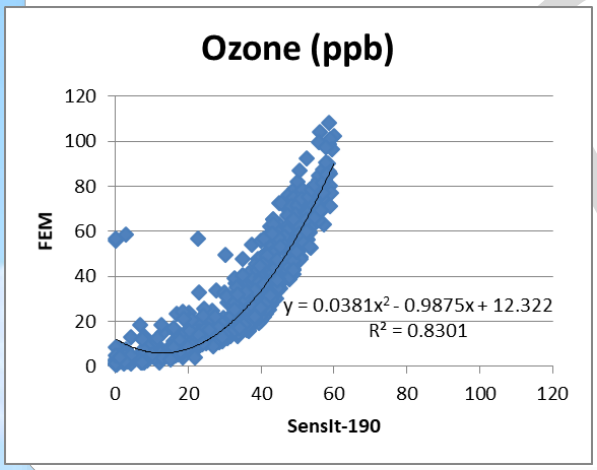


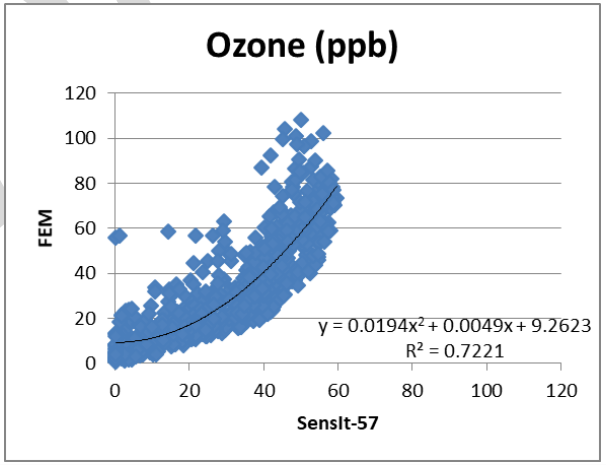


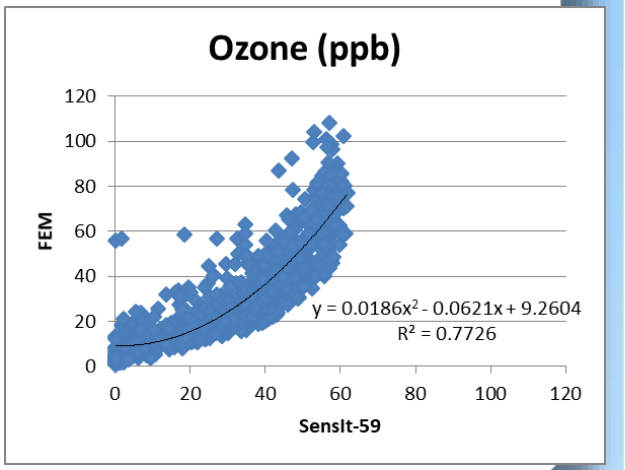
SENS-IT vs FEM (Ozone; 1-hr mean)



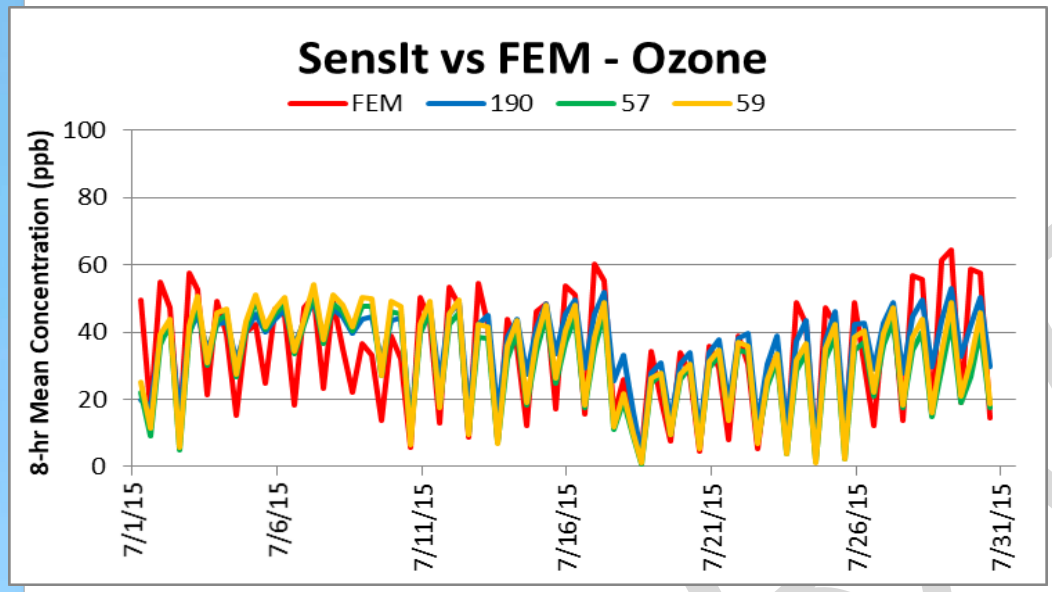
- Ozone measurements correlate very well with the corresponding FEM data ($0.72<R^2<0.83$), but the three SENS-IT sensors underestimated measured Ozone concentrations



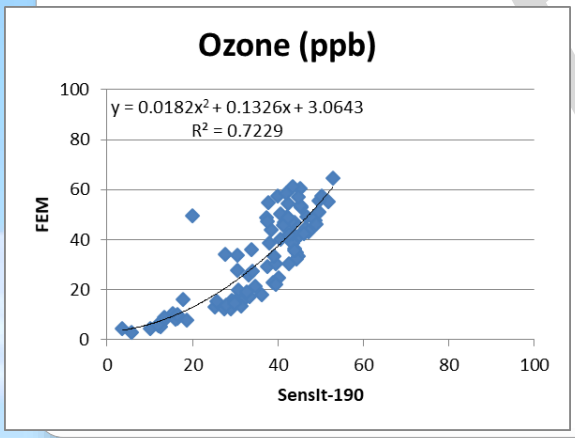


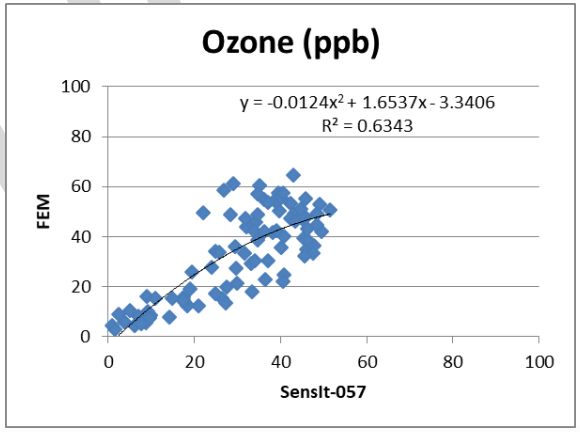


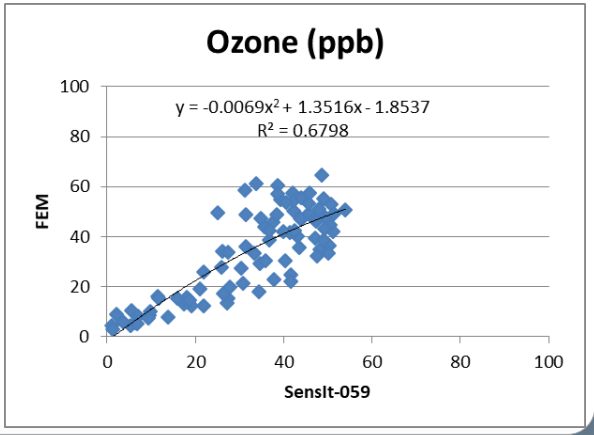
SENS-IT vs FEM (Ozone; 8-hr mean)



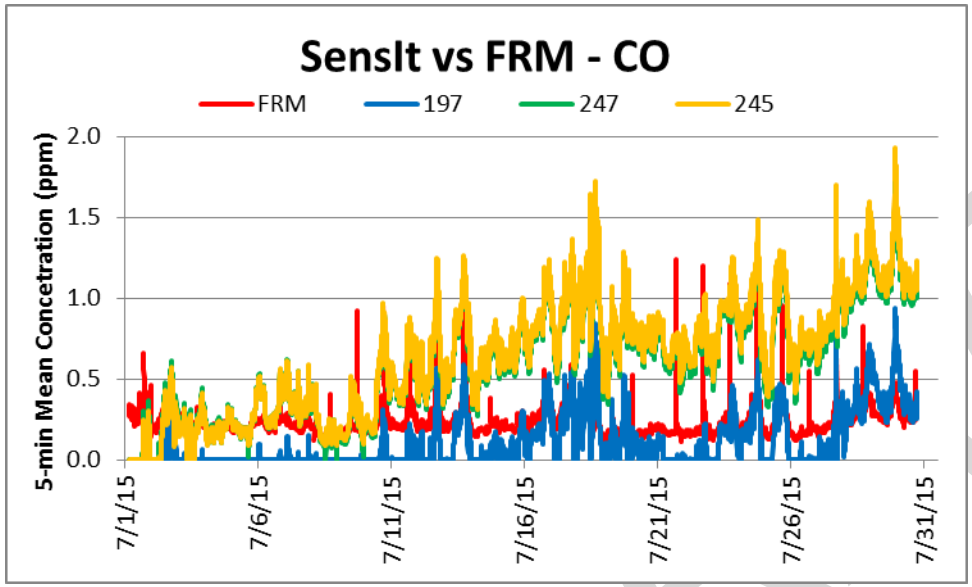
- Ozone measurements correlate well with the corresponding FEM data ($0.63<R^2<0.72$)



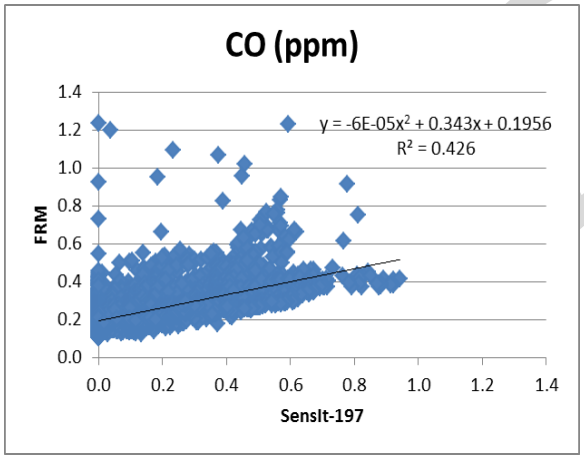


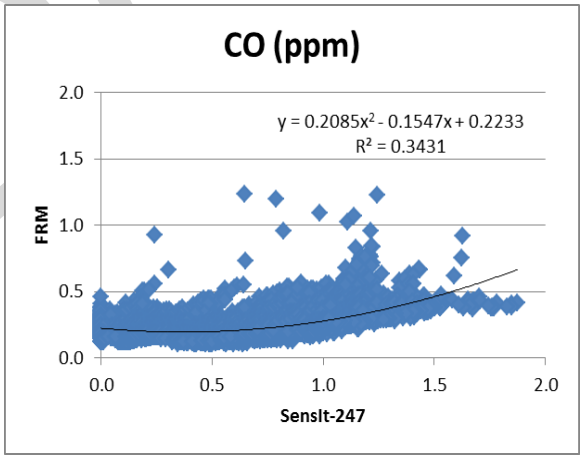


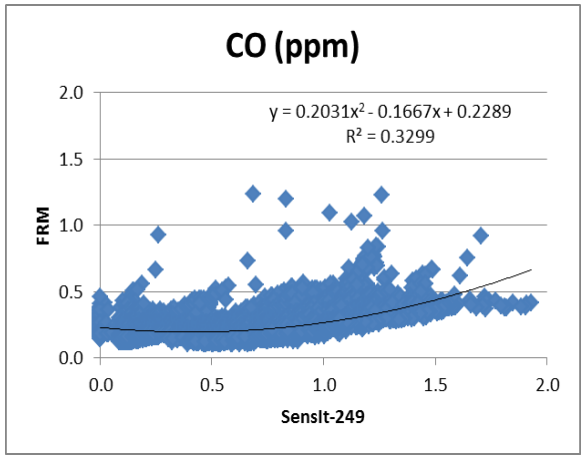
SENS-IT vs FRM (CO; 5-min mean)



- Poor correlation between CO measurements and the corresponding FRM data ($0.33<R^2<0.43$)







Discussion

- Data recovery from the tested SENS-IT Sensors was very high (i.e. no down time over a period of one month)
- Overall, all SENS-IT devices were characterized by low intra-model variability despite the fact that one CO unit produced invalid data
- Despite the good correlation (R^2) between the NO_2 sensors and the corresponding FRM instrument, the magnitude of the NO_2 sensor measurements was largely overestimated. Conversely, although the Ozone sensors were well correlated with a substantially more expensive FEM instrument, the magnitude of the Ozone sensor measurements was underestimated
- The CO sensors correlate poorly with the corresponding FRM monitor
- It should be noted that no sensor calibration had been performed by SCAQMD Staff prior to the beginning of this field testing
- Laboratory chamber testing under temperature- and relative humidity- controlled conditions, known individual gas concentrations and known concentrations of interferent gas mixtures is necessary to fully evaluate the performance of these Unitec SENS-IT sensors

- All results are still preliminary